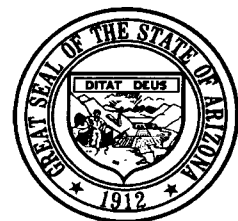


Groundwater Quality Management Program



7.1 INTRODUCTION

Water quality is an important component in the management of the water supply in the Santa Cruz Active Management Area (AMA). The role of the Arizona Department of Water Resources (Department) in water quality relates to the impacts of water quality on available water supplies. Protecting and managing water quality maximizes the overall quantity of usable water, and matching the best use to the quality of water is a significant aspect of meeting the Department's water management objectives. This chapter defines the Department's role and authority in groundwater quality management during the third management period and addresses water quality impacts on the management of water supplies in the Santa Cruz AMA.

The Department's water quality responsibilities include enhancement of groundwater quality protection programs, assistance in the cleanup of contaminated areas, and assistance in matching water quality with the highest beneficial use. In the third management period, the Department will play a greater role in water quality issues because of increased responsibilities and funding for water quality management activities provided for in the 1997 Water Quality Assurance Revolving Fund (WQARF) Program reform legislation. Laws 1997, Ch. 287. Furthermore, the utilization of effluent as well as the designation of end uses for remediated groundwater will play a larger role in water supply decisions during the third management period.

In general, groundwater in the Santa Cruz AMA is of acceptable quality for most uses. Most of the groundwater resources meet federal and state drinking water standards, though contaminant levels exceed primary safe drinking water standards in a few areas. Water withdrawn from wells within these identified areas has been discontinued or the contaminated water is in the process of being cleaned up. Other areas of known contamination which are not being remediated are monitored to ensure that contaminants do not spread.

In this chapter, the following topics are discussed in the order listed:

- Goals and Objectives
- Statutory Provisions
- Regulation of Groundwater Quality in Arizona
- Water Quality Assessment
- Third Management Plan Program Summary
- Future Directions

7.2 GOALS AND OBJECTIVES

The Department recognizes that the goal of remediating contaminated groundwater is important and intends to facilitate such remediation by implementing incentives for remediated groundwater use. However, the Department has the responsibility in the Santa Cruz AMA of maintaining safe-yield conditions and preventing long-term declines in local water table levels. In order to protect and ensure effective water management remediation incentives should be consistent with the AMA water management goals. Coordinated efforts between the Arizona Department of Environmental Quality (ADEQ) and the Department will help to ensure that water management and water quality objectives are both met.

To achieve its groundwater quality management objectives, the Department will "coordinate and confer" with ADEQ regarding "water plans, water resource planning, water management, wells, water rights and permits, and other appropriate provisions of [Title 45] pertaining to remedial investigations, feasibility studies, site prioritization, selection of remedies and implementation of the [WQARF] program pursuant to title 49, chapter 2, article 5." A.R.S. § 45-105(B)(4)(c). A Memorandum of Understanding between the Department and ADEQ will be developed to address this cooperative effort.

The Department's goals and objectives for groundwater quality management for the third management period are as follows:

- to ensure that remediation of contaminated groundwater uses the least amount of groundwater necessary to facilitate the objectives of each remedial action project.
- to ensure that end uses of remediated groundwater minimize water withdrawn from wells and is consistent with the maintenance of safe-yield conditions and the prevention of long-term declines in local water table levels.
- to ensure that water quality considerations affecting Department programs that extend beyond the scope of the WQARF Program are also addressed in order to preserve groundwater quality and quantity. Some of these considerations include well construction and abandonment standards, well spacing, assured water supply, recharge, and groundwater withdrawal permits.

Pursuant to the WQARF Program, the Department will respond first to the highest ranked sites on the WQARF site registry. The Department's objectives are to ensure that remedial action projects are not an impediment to achieving the management goals for each AMA, and that cleanups are performed in a prudent and efficient manner from a water management perspective.

7.3 STATUTORY PROVISIONS

ADEQ is the agency primarily responsible for regulating water quality. The Department also has some limited responsibilities in this area. Statutory provisions pertaining to the Department's limited authority to regulate groundwater quality are discussed below.

The Code grants the Department authority to regulate groundwater. Under the Code, the Department has the following authority and responsibilities relating to water quality:

- “[T]he director may ... [f]ormulate plans and develop programs for the practical and economical development, management, conservation and use of surface water, groundwater and the watersheds in this state, including the management of water quantity and quality.” A.R.S. § 45-105(A)(1).
- “[T]he director may ... [c]onduct feasibility studies and remedial investigations relating to groundwater quality and enter into contracts and cooperative agreements under § 104 of the comprehensive environmental response, compensation, and liability act of 1980 (P.L. 96-510) to conduct such studies and investigations.” A.R.S. § 45-105(A)(16).
- For the third management period, the director “shall, in cooperation with the department of environmental quality, include in each [management] plan an assessment of groundwater quality in the active management area and any proposed program for groundwater quality protection. Any such program shall be submitted to the legislature for any necessary enabling legislation or coordination with existing programs of the department of environmental quality.” A.R.S. § 45-566(A)(7).
- “[T]he director shall consult with the department of environmental quality on water quality considerations in developing and implementing management plans under this article.” A.R.S. § 45-573.

The WQARF legislation, as revised in 1997, expands the Department's role in water quality management. The Department's responsibilities and authority under WQARF, which will be explained in greater detail later in this chapter, include the following:

- “[T]he director of water resources, in consultation with the director of environmental quality, may inspect wells for vertical cross-contamination of groundwater by hazardous substances and may take appropriate remedial actions to prevent or mitigate the cross-contamination” A.R.S. § 45-605(A).
- “[T]he director [of water resources] shall notify an applicant for a permit or a person who files a notice of intent to drill a new or replacement well if the location of the proposed well is within a subbasin where there is a site [with existing or future groundwater contamination presenting a risk of vertical cross-contamination by the well].” The director is also required to adopt rules relating to vertical cross-contamination and new or replacement wells. A.R.S. § 45-605(E).
- “[T]he director of environmental quality and the director of water resources shall coordinate their efforts to expedite remedial actions, including obtaining information pertinent to site investigations, remedial investigations, site management and beneficial use of remediated water.” A.R.S. § 49-290.01(C).
- The director of water resources may waive permits, approvals or authorizations if they “unreasonably limit the completion of a remedial action.” A.R.S. § 49-290.01(A). The director of water resources may also waive any regulatory requirement under Title 45 if the requirement conflicts with the selected remedy in a remedial action as long as the waiver does not “result in adverse impacts to other land and water users.” A.R.S. § 49-290.01(D).
- “The department of water resources shall include in its management plans ... provisions to encourage the beneficial use of groundwater that is withdrawn pursuant to approved remedial action projects” Laws 1997, Ch. 287, Sec. 51. In order to encourage the beneficial use of remediated groundwater, “the department of water resources shall account for groundwater withdrawn pursuant to approved remedial action projects under CERCLA or title 49, Arizona Revised Statutes, consistent with the accounting for surface water” for purposes of determining compliance with management plan conservation requirements. Laws 1997, Ch. 287, Sec. 51(B).
- “For each calendar year until 2025, the use of up to an aggregate of sixty-five thousand acre-feet of groundwater withdrawn within all active management areas pursuant to approved remedial action projects under CERCLA or Title 49, Arizona Revised Statutes, shall be considered consistent with the management goal of the active management area as prescribed in section 45-576, subsection I, paragraph 2, Arizona Revised Statutes.” Additionally, in the third management period, 50 percent of the total volume of groundwater withdrawn pursuant to remedial action projects and in excess of the aggregate volume of 65,000 acre-feet shall be considered consistent with the management goal of the AMA. Laws 1997, Ch. 287, Sec. 52.
- “The department of environmental quality and the department of water resources shall develop a method of sharing data, including cooperative data base development and integration between the departments, that will provide the departments with the information necessary to protect the resources of the state.” Laws 1997, Ch. 287, Sec. 53.
- “The directors of environmental quality and water resources shall enter into an agreement to coordinate the well inspection and remediation programs and to rank wells within an area of contamination according to each well's potential to act as a conduit to spread contamination and to

determine the appropriate remedial action regarding the wells with a potential to act as a conduit, including well reconstruction, well abandonment or no action.” Laws 1997, Ch. 287, Sec. 54.

7.4 THE REGULATION OF GROUNDWATER QUALITY IN ARIZONA

To understand the Department’s role in regulating groundwater quality, it is important to understand the broad framework of laws and programs impacting both groundwater and surface water quality. Since groundwater quantity and quality issues are so interrelated, ADEQ and the Department work together to prevent and mitigate groundwater quality and quantity problems. ADEQ has the lead role in protecting the State’s groundwater quality and surface water quality, while the Department secondarily manages groundwater quality concerns. This section discusses the regulatory agencies responsible for administering laws impacting groundwater and surface water quality as well as the federal laws and state programs impacting groundwater and surface water quality.

7.4.1 Water Quality Regulatory Agencies

Water quality protection programs in Arizona are based on both federal and state law and are primarily administered by either ADEQ or the United States Environmental Protection Agency (EPA) Region IX. ADEQ has the responsibility to administer state water quality programs pursuant to state statutes and to administer federal water quality programs for which the EPA has delegated its authority to the state, sometimes referred to as state primacy. EPA has the responsibility to administer federal water quality programs pursuant to federal statutes, but may delegate its authority to states that demonstrate the ability to administer such programs.

ADEQ has authority pursuant to the Arizona Environmental Quality Act (EQA) of 1986 to set water quality standards and to regulate discharges that may impact the quality of groundwater by requiring a discharger to obtain an Aquifer Protection Permit (APP). ADEQ also has authority over remediation of contaminated groundwater under WQARF. ADEQ has authority under the Clean Water Act (CWA) to set Arizona’s surface water quality standards and to certify that discharges subject to federal permits do not violate state water quality standards. Moreover, ADEQ has authority to regulate drinking water under the Safe Drinking Water Act (SDWA) and hazardous waste under the Resource Conservation and Recovery Act (RCRA).

EPA Region IX retains authority to administer the CWA National Pollutant Discharge Elimination System (NPDES) permits and the pretreatment program, while the United States Army Corps of Engineers, Los Angeles District, has authority to administer CWA permits for the discharge of dredge or fill materials in Arizona’s waters. EPA Region IX also has authority to require groundwater monitoring and remediation in accordance CERCLA.

7.4.2 Federal Laws Impacting Groundwater Quality

The SDWA is the primary federal law regulating groundwater quality. In particular, it regulates drinking water from all sources including groundwater. The CWA, which regulates surface water, also impacts groundwater quality. CERCLA and the RCRA impact groundwater management through the regulation of hazardous waste and sites contaminated by hazardous waste. Following is a brief overview of these federal laws and their impacts on the Department’s water quality management.

7.4.2.1 Safe Drinking Water Act

The SDWA was enacted in 1974 to regulate drinking water. ADEQ has been delegated authority by the EPA to implement the SDWA and “to ensure that all potable water distributed or sold to the public

through public and semipublic water systems is free from unwholesome, poisonous, deleterious, or other foreign substances and filth or disease causing substances or organisms.” A.R.S. § 49-351(A).

There are two types of standards set by the SDWA: national primary drinking water regulations and national secondary drinking water regulations. National primary drinking water standards may either be primary Maximum Contaminant Levels (MCLs) or Treatment Techniques (TT) requirements. Primary MCLs are the maximum permissible level of a constituent in a public water system and constitute the enforceable standard for safe drinking water. TT requirements set action levels for constituents such as lead and copper that cannot be directly detected or removed by water systems. National secondary drinking water regulations, referred to as secondary MCLs, set non-enforceable numeric standards for the aesthetic quality of the water, such as taste, odor, or color. Water with contaminants above the secondary MCLs are not typically expected to cause health problems. ADEQ has adopted the EPA MCLs as state Drinking Water Standards and has the authority to adopt more stringent standards as well.

Although the Department does not directly regulate drinking water quality, the presence of contaminants that exceed federal and state standards impacts the regulation of municipal providers and poses significant water management issues for drinking water systems.

7.4.2.2 Clean Water Act

The CWA, first passed in 1972, is the comprehensive federal statute regulating surface water quality. The CWA contains six major elements: (1) the NPDES permit program which regulates discharges of pollutants by any person to the nation’s waters and is designed to protect the chemical and biological integrity of the nation’s waters, (2) technology-based effluent standards that apply to the quality of a facility discharge, (3) state ambient water quality standards, (4) dredge and fill permits designed to protect the physical and biological integrity of the nation’s waters, (5) oil and hazardous substance spill liability, and (6) federal grant programs for improvement of municipal water treatment.

Under the NPDES permit program, all point source dischargers of pollutants into “waters of the United States” must obtain a permit. The jurisdictional reach of the CWA extends to “navigable waters” which are defined as “waters of the United States, including the territorial seas.” 33 U.S.C. § 1362(7). EPA and the Corps define “waters of the United States” to include interstate waters; waters which are used, were used in the past, or may be susceptible to use in interstate or foreign commerce; waters the use, degradation, or destruction of which would or could affect interstate or foreign commerce; tributaries to such waters; the territorial sea and wetlands. 40 C.F.R. §122.2; 33 C.F.R. § 328.3(a). A frequently cited definition of “waters of the United States” is

any waterway within the United States also including normally dry arroyos through which water may flow, where such water will ultimately end up in public waters such as a river or stream, tributary to a river or stream, lake, reservoir, bay, gulf, sea or ocean within or adjacent to the United States. *U.S. v. Phelps Dodge Corp.*, 391 F. Supp. 1181 (D. Ariz. 1975).

Based on this “tributary rule,” the CWA has potential application to dry land which drains into a water of the United States. Additionally, EPA interprets waters of the United States to include wetlands, areas susceptible to use as habitat by migratory wildfowl, and areas where industries engage in interstate commerce discharge. 44 Fed. Reg. 32854, 32858 (June 7, 1979); 51 Fed. Reg. 41206, 41217 (Nov. 13, 1986). “Point source” means:

any discernible, confined, and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal

feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. 33 U.S.C. § 1362(11).

“Pollutant” includes dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal and agricultural waste discharged into water. 33 U.S.C. § 1362(6). Based on the expansive definitions of “waters of the United States,” “point source,” and “pollutant,” the jurisdictional reach of the CWA NPDES Program is quite broad. The EPA has also implemented a NPDES storm water permit program that regulates municipal and industrial runoff which eventually discharges to waters of the United States.

NPDES permits that allow discharges to canals or river systems as a result of remedial projects or by wastewater treatment facilities are important to the Department’s overall water management strategy. As a result, the Department provides input on related reports and draft NPDES permits that may impact the water management activities in the state. Furthermore, non-point source contamination of groundwater by such substances as nitrate, sulfate, and dissolved solids can render large volumes of groundwater unusable for many purposes and pose serious water management problems. Therefore, the Department monitors statutory and programmatic developments as well as permits and reports related to non-point source discharges under the CWA.

The CWA also provides for area-wide long range planning processes to mitigate water quality control problems in selected areas which result from urban and industrial wastewater. Because such planning processes include a comprehensive review of wastewater treatment and reuse options, the Department participates in this planning process and provides technical assistance to the local councils of government administering the plans.

7.4.2.3 Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA and the Superfund Amendments and Reauthorization Act, commonly referred to as the federal Superfund program, authorize investigation and remediation of groundwater contaminated by releases of hazardous substances. Groundwater remediation may be required to comply with primary MCL standards, although less stringent standards may be approved by EPA on a case-by-case basis through a technical waiver process. In Arizona, CERCLA establishes a comprehensive response program which is administered by ADEQ in cooperation with the EPA. The Department also plays an advisory role in this process.

Under Section 105 of CERCLA, the EPA is required to annually update the National Priority List (NPL) of Superfund sites. Sites are proposed for inclusion on the NPL after being assessed as to the release of hazardous substances that threaten public health and the environment. Two significant components in the Superfund process are site investigation (Remedial Investigation) and evaluation of possible cleanup alternatives (Feasibility Study). During the Remedial Investigation, information is gathered to determine the general nature, extent, and sources of contamination at a site. Once the final cleanup plan has been selected, EPA formalizes this decision by signing a “Record of Decision” (ROD). The ROD also contains a Responsiveness Summary which is EPA’s response to public comments on the Remedial Investigation, Feasibility Study, and Proposed Plan. Design and actual cleanup activities (Remedial Design and Remedial Action) can then proceed.

The Department regularly participates in CERCLA Program activities, primarily for sites located within AMA boundaries. The Department’s concern at CERCLA sites is that any groundwater withdrawn and remediated be put to reasonable and beneficial use. The Department participates on CERCLA technical committees and serves in an advisory capacity for monitoring and extraction well installation, source control projects, and permitting.

7.4.2.4 Resource Conservation and Recovery Act

The RCRA established a national hazardous waste management program in 1976. Under RCRA, hazardous waste permits are issued for the treatment, storage, and disposal of hazardous wastes. Individual permits issued to these facilities specify design, performance, and operational standards which include groundwater monitoring. Hazardous waste facilities also undergo a closure process once operations are reduced or terminated. Moreover, corrective action may be required at treatment, storage, and disposal facilities and may include groundwater monitoring.

ADEQ has been delegated authority for the implementation of RCRA requirements in Arizona. The Department's participation at RCRA sites is important for water management activities, particularly in regard to well siting, use permits, and end use issues.

7.4.3 ADEQ Groundwater Programs

The EQA (A.R.S. § 49-101, *et seq.*) established the ADEQ and created a strong and comprehensive water quality management structure. ADEQ's programs that protect groundwater resources include water quality assessments, groundwater monitoring, pollutant discharge monitoring, permitting activities, and remediation activities. The following are selected water quality protection programs which fall under the jurisdiction of ADEQ and have a direct impact on Department activities.

7.4.3.1 Aquifer Water Quality Standards

Arizona's Aquifer Water Quality Standards (AWQSs) are the cornerstone of the State's groundwater protection program. Arizona has adopted the federal primary MCLs, established under SDWA, as numeric AWQSs. A.A.C. R18-11-406. These standards apply to aquifers that are classified and protected for drinking water use. Because all aquifers in Arizona are classified and protected for drinking water use, Arizona's AWQSs are enforceable water quality standards in all of Arizona's aquifers. A.R.S. § 49-224(B).

ADEQ may reclassify an aquifer within an AMA, upon consultation with the appropriate Groundwater Users Advisory Council and upon conducting a public hearing, for a projected use other than drinking water if the identified aquifer is hydrologically isolated from the other aquifers or other portions of the same aquifer, water from the identified aquifer is not being used as drinking water, and the benefits to the public of the resulting water quality degradation outweigh the costs. A.R.S. § 49-224(c).

Arizona has also adopted narrative AWQSs to regulate pollutant discharges for which no numeric standards have been developed. Arizona's narrative AWQSs include the following: (1) a discharge shall not cause a pollutant to be present in an aquifer classified for a drinking-water-protected use in a concentration which endangers human health, (2) a discharge shall not cause or contribute to a violation of a surface water quality standard established for a navigable water of the state, and (3) a discharge shall not cause a pollutant to be present in an aquifer which impairs existing or reasonably foreseeable uses of water in an aquifer. A.A.C. R18-11-405.

7.4.3.2 Aquifer Protection Program

The most comprehensive ADEQ groundwater protection program is the APP system, established by the EQA in 1986 and implemented by rule in 1989. An individual or general permit is required for any person who discharges or who owns or operates a facility that discharges a pollutant from a facility either directly into an aquifer or to the land surface or the vadose zone in such a manner that there is a reasonable probability that the pollutant will reach an aquifer. A.R.S. §§ 49-201(11), 49-241. Discharging facilities that require either an individual or general permit to operate include surface impoundments, solid waste

disposal facilities, injection wells, land treatment facilities, facilities which add a pollutant to an assortment of salt formations, dry well, or underground cave or mine; mine tailings piles and ponds, mine leaching operations, large septic tank systems, effluent recharge projects, point source discharges to waters of the United States, and sewage or sludge ponds and wastewater treatment facilities. A.R.S. § 49-241(B). Classes or categories of facilities which are exempted from APP requirements are identified in A.R.S. § 49-250. General permits are issued by rule while individual permits must be applied for on a facility by facility basis.

APPs require a demonstration that AWQSS are maintained and the Best Available Demonstrated Control Technology (BADCT) is applied. For individual APPs, compliance with AWQSS is measured at a designated point of compliance. BADCT requirements ensure that the greatest degree of discharge reduction is achieved through an evaluation of site-specific engineering, environmental, and economic criteria.

APPs may require compliance with best management practices (BMPs). BMPs are typically site design techniques used to protect water quality. BMPs may be adopted to manage urban runoff, storm sewers, silvicultural activities, and septic tank systems. Agricultural general permits require compliance with BMPs for nitrogen fertilizer application and concentrated animal feeding operations. ADEQ is required to monitor compliance with the established BMPs and to measure BMP effectiveness.

Department staff receives and reviews all APPs for any impacts on Departmental programs and water management. In particular, the Department coordinates with ADEQ to review APP applications for potential harmful water quality impacts on groundwater conditions. Pursuant to A.A.C. R18-9-109, ADEQ advises the Department of each APP application received for a facility that is a recharge project or an underground storage and recovery project. One of the conditions for the issuance of an underground storage facility permit is that ADEQ must determine that the facility is not in a location which will result in pollutants being leached to the groundwater table so as to cause unreasonable harm. A.R.S. § 45-811.01(C). Facilities exempt from APP provisions may be required by the Department, in consultation with ADEQ, to meet other requirements to mitigate harmful water quality impacts to the aquifer.

7.4.3.3 Wellhead Protection Program

ADEQ's Wellhead Protection Program is an important supplement to groundwater quality protection provided by the Department's well construction standards and well driller licensing programs. The Wellhead Protection Program fulfills federal requirements of Section 1428 of the SDWA by designating Wellhead Protection Areas around public drinking water systems. The Wellhead Protection Program is a voluntary program which encourages the protection of all wells, not just public drinking water system wells. Local entities that have the authority to control land use and exercise other management options can implement wellhead protection, therefore encouraging the creation of local programs.

7.4.3.4 Reuse Permits

Reuse permits are issued to facilities which provide wastewater for reuse. A reuse permit specifies the amount of effluent to be reused and its chemical quality. ADEQ wastewater reuse rules (A.A.C. R18-9-701, *et seq.*) set the criteria for the use of treated effluent, or reclaimed water, for purposes such as agricultural irrigation, turf irrigation, and recharge. The current reuse rules prescribe numeric reclaimed water quality criteria and monitoring requirements for specific reuse applications. In general, these rules prescribe allowable limits for pH, total fecal coliform, turbidity, enteric viruses, and certain parasites. Reuse may be limited depending on the quality of source water and the intended use.

Wastewater reuse rules undergo periodic updating through ADEQ's rule-making process. The Department reviews any proposed changes to the wastewater reuse rules to ensure the protection of public health and groundwater supplies while maximizing the use of a significant renewable water supply. The Department evaluates effluent reuse permits issued by ADEQ and encourages the use of treated effluent where appropriate.

7.4.3.5 Underground Storage Tanks

ADEQ's Underground Storage Tank (UST) Program was developed to ensure the proper operation of USTs and to prevent and remediate releases. Under state regulation and RCRA amendments, the UST Program consists of notification requirements, technical standards for new and existing USTs, leak detection and closure criteria, corrective actions for remediation and financial responsibility demonstrations. Leaking USTs in a concentrated area can have detrimental impacts on groundwater quality and supplies.

The Department has the authority to issue poor quality groundwater withdrawal permits for water contaminated by USTs. The Department can provide guidance for UST site remediation projects to ensure the beneficial use of remediated water.

7.4.3.6 Water Quality Assurance Revolving Fund

The WQARF Program, sometimes referred to as the state Superfund program, was created as part of the EQA. WQARF monies are used to protect the waters of our state against hazardous substances and may be used in conjunction with federal funds. Funds can be used for statewide water quality monitoring, health and risk assessment studies, and remediating hazardous substances which threaten the waters of the state. Mitigation of non-hazardous substances is also allowed under specified conditions. A.R.S. § 49-286. Each year, ADEQ develops a list of environmentally threatened sites which qualify for WQARF monies which is based in part on the degree of risk to the environment and other available funding sources. Funds are used at those sites to mitigate existing contamination or to prevent further spread of pollutants that may threaten water supplies.

Some of the key legislative changes made in the 1997 WQARF reform package include: (1) establishment of a proportional share liability for cost allocation to responsible parties; (2) creation of a neutral party arbitration process, with incentives to encourage early settlements and disincentives to responsible parties who do not enroll in the neutral party arbitration process; (3) new ADEQ funding mechanisms designed to protect existing wells against migrating contamination from WQARF sites; (4) the creation of a comprehensive WQARF site registry, which consolidates a number of separate lists which were previously used; (5) the inclusion of petroleum releases in the WQARF Program under some circumstances; and (6) increased flexibility in the selection of groundwater remedies.

ADEQ follows a process for management and cleanup of WQARF sites which consists of site identification and characterization, site prioritization, remedy selection, identification of end uses, implementation and monitoring, and closure. The criteria used to evaluate of response actions include practicability, risk, cost, and benefit. This process also includes a comparison of alternatives based on established statutory criteria, developing a Remedial Action Plan (RAP), obtaining public comment, and issuing a ROD. The Department will actively coordinate with ADEQ in the planning and implementation of groundwater cleanup actions under WQARF.

7.4.3.7 Water Infrastructure Finance Authority

In 1989, the Arizona legislature created the Wastewater Management Authority to administer funds granted to the state pursuant to the federal SDWA. These funds, which required a 20 percent state match,

were loaned to wastewater treatment facilities for assistance in meeting the SDWA requirements. The ADEQ made loans for this purpose from monies in the ADEQ wastewater treatment revolving fund.

In 1997, this administrative body was amended by the legislature and renamed the Water Infrastructure Finance Authority (WIFA). The authority of WIFA was expanded to make loans available to drinking water systems in addition to wastewater treatment systems for assistance in meeting requirements of the SDWA. The state funding source was also changed so that monies made available to these systems are now derived from the drinking water revolving fund. The Department participates on the advisory board which oversees the WIFA and has an interest in viability of water systems and SDWA compliance.

7.4.4 The Department's Programs Related to Groundwater Quality

The Department protects groundwater quality by considering groundwater quality issues in its permitting process and water quantity management programs. As a result of WQARF reform legislation in 1997, the Department has increased its responsibility in the program to coordinate and provide assistance to WQARF activities. Among other things, the bill provides for:

- annual funding for Department WQARF activities;
- database development and coordination with ADEQ;
- groundwater withdrawn pursuant to certain cleanups to be accounted for in the same manner as surface water for the purpose of determining compliance with conservation requirements;
- amendment of the Assured Water Supply Rules (AWS Rules);
- active involvement by the Department in all phases of site assessment, remediation, management, operation, and planning strategies;
- a WQARF Advisory Board on which the Department has a seat; and
- a well inspection program through which wells that are contributing to vertical cross-contamination may be identified and modified.

The Department's existing permits and programs that involve groundwater quality issues as well as its new programs for groundwater quality protection based on the WQARF legislation are discussed in the following subsections.

7.4.4.1 Poor Quality Groundwater Withdrawal Permits

Appropriate use of poor quality groundwater conserves the existing supply of potable groundwater. The Department issues poor quality groundwater withdrawal permits to allow the withdrawal of groundwater that, because of its quality, has no other beneficial use at the present time. A.R.S. § 45-516. Withdrawal permits are issued by the Department, and the withdrawal must be consistent with the AMA management plan. Permits are usually issued in conjunction with CERCLA, WQARF, or leaking UST sites for pump and treat operations. To increase the appropriate uses of poor quality groundwater during the third management period, the Department will continue to encourage matching poor quality groundwater with beneficial uses within the AMA.

7.4.4.2 Assured Water Supply Program

The Assured Water Supply Program (AWS Program) is a consumer protection program that ensures that new subdivisions have a secure supply of water with adequate quality for at least 100 years. The AWS Program is described in detail in Chapter 5, section 5.3.

In assessing the quality of a water supply pledged for assured water supply purposes, the Department works closely with ADEQ to determine whether the water supply meets ADEQ standards for the purposes

for which the water is pledged. If the water is not of adequate quality, the applicant may need to find alternative water sources or expend additional resources treating the water to meet the ADEQ standards.

7.4.4.3 Underground Water Storage and Recovery

Underground water storage, also known as recharge, may be helpful in maintaining safe-yield conditions and preventing long-term declines in water table levels in the Santa Cruz AMA. The underground water storage program is administered by the Department and described in detail in chapter 8, section 8.3. Permits must be obtained from the Department prior to undertaking recharge activities. The Department coordinates closely with ADEQ to ensure that underground water storage does not adversely impact existing aquifer water quality and does not cause movement of existing groundwater contamination. If effluent is stored underground, the applicant must obtain an APP from ADEQ, in addition to the underground storage permits required from the Department.

7.4.4.4 Well Spacing/Impact Analysis

A.R.S. § 45-598 and the Department's temporary general Well Spacing and Well Impact Rules require well impact studies to evaluate the potential for new non-exempt wells and new withdrawals to damage land and other water users, particularly existing well operations. The Department conducts the impact studies for wells with a maximum discharge of 500 gallons per minute (gpm) or less. For wells with a maximum discharge rate exceeding 500 gpm, the permit applicant must submit a hydrological study of projected water level declines due to the operation of the proposed well. The study must also assess potential adverse impacts from the migration of poor quality groundwater. The well permit application may be denied if the Department determines that the proposed well would cause an unreasonable and adverse impact on surrounding wells, additional regional land subsidence, or migration of poor quality groundwater. Wells which withdraw less than 35 gpm are currently exempt from these requirements.

7.4.4.5 Well Construction and Abandonment Requirements and Licensing of Well Drillers

If wells are not constructed, sealed, or abandoned properly they can act as conduits for contaminant flow from the surface to groundwater or between aquifers. The Department's rules governing well construction, abandonment, and driller licensing, set forth at A.A.C. R12-15-801, *et seq.*, are summarized below.

- Minimum well construction and abandonment requirements prevent entry of fluids at and near the surface and minimize the possibilities of migration and inadvertent withdrawal of poor quality groundwater. These requirements also prohibit the use of hazardous materials in the construction of wells.
- Installation, modification, abandonment, or repair of all wells in Arizona must be performed by a driller licensed by the Department. The licensing procedure includes the administration of written examinations to test the applicant's knowledge of state regulations, hydrologic concepts, and well construction principles and practices.
- Disposal site restriction prevents the use of wells as disposal facilities for any material that may pollute groundwater.
- Special standards may be required by the Department if the minimum well construction requirements do not adequately protect the aquifer or other water users.
- Open wells must be capped with a water-tight steel plate.

- Except for monitor and piezometer wells, no well shall be drilled within 100 feet of any septic tank system, sewage disposal area, landfill, hazardous waste facility or storage area, or petroleum storage areas and tanks, unless authorized by the director.

Wells drilled prior to the enactment of the well construction rules (effective March 5, 1984) were not required to be constructed in accordance with minimum well construction standards. If a pre-rule well is replaced or modified, however, the new or modified well must meet the current well construction standards. See A.R.S. § 45-594.

7.4.4.6 The Department's Role in the WQARF Program

The Department's involvement in groundwater remediation has been redefined in the WQARF reform bill as a result of recommendations made by the Groundwater Cleanup Task Force, which conducted an extensive series of stakeholder negotiations designed to promote groundwater cleanup and groundwater quality management activities of remedial sites. Involvement in this development process was widespread and representative of a varied group of private and public interests.

7.4.4.6.1 Department Activities in the WQARF Site Cleanup and Management Process

ADEQ's WQARF site cleanup and management process and the Department's role in that process are described in the following discussion.

Site Identification and Characterization

Existing WQARF sites have been identified and are being managed by ADEQ. Additional sites may be identified in the future based on a preliminary investigation by ADEQ to determine the potential risk to public health, welfare or the environment. The Department will further assist ADEQ in this process by providing resource data which includes well location and pumpage records, water rights information, and any other appropriate data recorded by the Department.

Characterization of sites is important because the nature and extent of contamination must be understood before remedies can be selected and implemented. An important part of site characterization is an evaluation of how contamination impacts current and future groundwater uses. The Department's role may include such activities as site inspections and evaluations, review of investigations, field work such as well inspection and water quality sampling, identification of potential water management issues, and any other characterization as appropriate. Department computer models may be useful in characterizing groundwater flow patterns.

Site Prioritization

The results of the preliminary investigation will be used by ADEQ for site scoring using a method to be established in rules adopted by the ADEQ director. The completed preliminary investigation will be used by ADEQ to either make a determination of no further action on a site, or to prepare the site for inclusion on the Site Registry. In this latter case, a Site Registry report is prepared containing a description of the site, with its geographical boundaries indicated, and a score in accordance with the site scoring method to be established in rules and adopted by the ADEQ director. The Department will assist ADEQ by sharing pertinent water resource information.

Remedy Selection

ADEQ has established a list of response actions to be considered when managing a site. Based on the potential impact on current and future water uses, remedial action options must be evaluated and a RAP

developed. Each RAP is site-specific. The Department will assist in defining potential remedies to ensure the remedial approach is consistent with Department water management objectives and sound groundwater management practices that are publicly acceptable. The Department's level of assistance will vary based on the remedy selected. Possible remedies are listed in Appendix 7C.

Identification of Beneficial End Uses

The Department is committed to the beneficial use of groundwater withdrawn and treated at WQARF sites, along with other areas that have degraded groundwater quality. The Department will assist ADEQ with the identification and facilitation of designated end uses for remedial projects. These end uses should be consistent with those determined for existing sites as well as the development of new end uses to match the intended use.

Implementation and Monitoring

The implementation and monitoring phase of a site activity includes construction, startup, monitoring, operation and maintenance, and any other appropriate activities. The Department will assist ADEQ in this phase through the following activities where appropriate: field work, review of groundwater analyses, pertinent groundwater and assured water supply accounting, and any other appropriate activities.

Site Closure

ADEQ must certify that site goals have been attained in order to discontinue cleanup activities. Department staff will assist in evaluation of sites and certification of site closure. The Department may need to identify alternative water sources to replace remediated water when sites are closed.

7.4.4.6.2 Department Policies for WQARF Site Cleanup and Management

In general, site cleanup plans should be consistent with the management goals of the AMA in which the site is located. A.R.S. §§ 49-282.06(F); 45-105(B)(4)(c). Therefore, the Department will implement policies during the third management period for the management and cleanup of remedial sites in cooperation with ADEQ. These policies will ensure that AMA goals are addressed when remedial actions are planned. The Department supports proposed remedial projects when they are appropriate, but believes that RAPs must make sense from a groundwater management perspective. The principles which will be used to formulate these policies are described below:

- **Water should be used consistent with water allocation concepts in Title 45.**

This policy requires that entities using water withdrawn pursuant to cleanups, whether under CERCLA, WQARF, RCRA, voluntary, or other sites, possess appropriate authorities for the use of groundwater (such as permits or water rights).

- **The Department supports source control cleanups to protect water sources.**

Source control, which controls pollution at its source, can be the most cost effective and practicable approach to cleanups. Source control projects to protect wells that are threatened by contaminant migration are generally supported by the Department. Pollution prevention is also a significant component of mitigating contaminant migration.

- **Any groundwater withdrawn must be put to reasonable and beneficial use.**

Reasonable and beneficial use of groundwater withdrawn is a policy that applies to all groundwater remediation efforts. Any withdrawals of 100 acre-feet or less per year may qualify for de minimis status and be exempted from beneficial use requirements, but the Department will evaluate de minimis exemptions from this policy on a case-by-case basis. In the case of leaking UST sites, the Department generally exempts sites that annually pump less than 10 or 15 acre-feet. The de minimis policy also facilitates the handling of small volumes of water pumped for the collection of groundwater sampling.

- **Contaminated groundwater represents a resource that has future importance.**

Contaminated groundwater is a resource that may be used for both potable and nonpotable uses. Potable uses must meet state and federal standards which regulate public consumption of drinking water. ADEQ and the Arizona Department of Health Services intend to develop end use standards for non-potable uses that, if implemented, will make large volumes of contaminated groundwater usable for specific purposes. The Department will cooperate in the development of non-potable end use standards and will develop policies for appropriate end uses based on the new standards.

- **Containment remedies that involve massive groundwater withdrawals to achieve regional groundwater flow control are generally inappropriate and will not be supported by the Department.**

In some cases, massive groundwater withdrawals of uncontaminated or only slightly contaminated water may be considered in order to control migration of contaminant plumes or for other purposes. In general, the Department considers these kinds of proposed remedies to be wasteful of groundwater and not cost-effective.

7.4.4.6.3 Statutory Mandates for the Department's Involvement in the WQARF Program

The 1997 WQARF reform legislation mandates that the Department implement certain water quality programs and provides for expanded Department involvement in water quality management. New Department programs and responsibilities based on the 1997 WQARF reform legislation include the following:

- **Remediated Groundwater Incentives**

The WQARF reform legislation of 1997 directs the Department to include in the management plans developed pursuant to A.R.S. § 45-566 (the Third Management Plans) provisions to encourage the beneficial use of groundwater that is withdrawn pursuant to approved remedial action projects under CERCLA or Title 49, Arizona Revised Statutes. Laws 1997, Ch. 287, § 51(A).

Remediated Groundwater Incentive for Conservation Requirement Accounting

In order to encourage the beneficial use of remediated groundwater, the Legislature specifically mandated:

In determining compliance with applicable conservation requirements adopted pursuant to sections 45-566, 45-567 and 45-568, Arizona Revised Statutes, the department of water resources shall account for groundwater withdrawn pursuant to approved remedial action projects under CERCLA or Title 49, Arizona Revised Statutes, consistent with the accounting for surface water.

Laws 1997, Ch. 287, § 51(B).

Remediated Groundwater Incentive for Assured Water Supply Accounting

In addition, the WQARF reform legislation of 1997 directs the Department to consider specified amounts of groundwater withdrawn pursuant to approved remedial action projects as consistent with the management goal of the active management area from which it is withdrawn for purposes of the Department's AWS Program. Laws 1997, Ch. 287, § 52. The Legislature mandated that:

For each calendar year until 2025, the use of up to an aggregate of sixty-five thousand acre-feet of groundwater withdrawn within all active management areas pursuant to approved remedial action projects under CERCLA or Title 49, Arizona Revised Statutes, shall be considered consistent with the management goal of the active management area.

Laws 1997, Ch. 287, § 52(A).

Once the aggregate volume of 65,000 acre-feet of remediated groundwater use by all users in all active management areas is reached in a year, the use of an additional amount of remediated groundwater is consistent with the management goal of the active management area based on a sliding scale. In the third management period, fifty percent of the total volume withdrawn in excess of the 65,000 acre-feet will be consistent with the management goal. Laws 1997, Ch. 287, § 52(B). By the year 2025, the remediated groundwater incentive for assured water supply accounting decreases to zero.

A municipal provider must apply for remediated groundwater accounting for an assured water supply determination prior to January 1, 2010. The amount of groundwater determined to be consistent with the management goal cannot exceed the amount that the municipal provider is legally obligated to withdraw or use and does not extend beyond 2025. Laws 1997, Ch. 287, § 52(C).

In AMAs where a mined groundwater account is created as part of an assured water supply determination (Phoenix, Tucson, and Prescott) annual groundwater withdrawals of 250 acre-feet or less that are withdrawn pursuant to an approved remedial action project shall not be debited against the mined groundwater account and shall not be subject to a replenishment obligation. The water provider must notify the Department of its compliance with this exemption. Annual withdrawals of 250 acre-feet or less of remediated groundwater will not count against the 65,000 acre-feet per year total volume. Laws 1997, Ch. 287, § 52(E).

Coordination with ADEQ in Evaluating Proposed Remedial Actions

Pursuant to A.R.S. § 45-105(B)(4)(c), the Department is required to actively coordinate and confer with ADEQ in evaluating proposed remedial actions to provide ADEQ with information regarding water resource considerations. The Department will coordinate and confer with ADEQ prior to ADEQ's approval or denial of a proposed remedial action project. Once a remedial action project is approved by ADEQ or the EPA pursuant to CERCLA or Title 49, A.R.S., the Department will account for remediated groundwater in accordance with Laws 1997, Ch. 287, §§ 51 and 52.

Among other things, the Department will consider the following factors relating to proposed remedial actions in its recommendations to ADEQ:

1) Volume of remediated groundwater to be withdrawn

The Department will encourage remedial actions that use the least amount of groundwater necessary to facilitate a project's remedial goal and will discourage remedial actions that are not prudent and efficient from a groundwater management perspective.

2) End uses to which remediated groundwater will be put

The Department will encourage end uses that are consistent with the AMA goals. Where remediated groundwater cannot be practicably or cost effectively re-injected or recharged, the Department will encourage replacing existing groundwater uses with remediated groundwater and preventing new permanent uses which would not have occurred without the incentive to use remediated groundwater and which would continue to rely on groundwater after the remediated groundwater is no longer available.

While individual circumstances will be evaluated on a case-by-case basis, generally, the Department's beneficial end use preferences are that the water would either be re-injected or recharged in the same local area or that existing groundwater uses would be replaced with use of remediated groundwater in the same local area.

Achievement of maximum beneficial use of waters and viability of proposed remedial action

Remedial actions must assure the protection of public health and welfare and the environment to the extent practicable, provide for the control, management or cleanup of hazardous substances so as to allow the maximum beneficial use of the waters of the state to be reasonable, necessary, cost-effective and technically feasible. A.R.S. § 49-282.06(A).

Consistency with Title 45

Groundwater withdrawn pursuant to an approved remedial action must be withdrawn and used consistent with Title 45, Arizona Revised Statutes.

- **Well Inspection, Modification, or Replacement**

The Department is required by the 1997 WQARF legislation to develop rules for well inspections. An evaluation of the extent of the cross-contamination problems will be performed by the Department in cooperation with ADEQ and other stakeholders.

- **Construction of New Wells In and Near WQARF Sites**

The 1997 WQARF legislation mandates that the Department ensure that new or replacement wells located in areas of known groundwater contamination are constructed in such a manner that cross-contamination does not occur. Department staff will screen Notices of Intent to Drill, including exempt wells, submitted to help ensure that wells are properly constructed. The Department will establish policies and procedures to implement this directive, including procedures to effectively communicate with well owners and drillers.

- **Abandonment of Wells In and Near WQARF Sites**

Department staff will review and evaluate Notices of Intent to Abandon to ensure that abandonment of wells is done in accordance with Department rules and that potential for cross-contamination is minimized.

7.5 WATER QUALITY ASSESSMENT

A water quality assessment must be included in management plans pursuant to the Code. The assessment provides an overview of water quality concerns in the Santa Cruz AMA. The following sections discuss the assessment goals and objectives, water quality of renewable and groundwater supplies, constituents of concern in the Santa Cruz AMA and their impact on water management, and specific contamination areas in the Santa Cruz AMA.

7.5.1 Assessment Goals and Objectives

The primary goal of the Third Management Plan Water Quality Assessment is to provide a general evaluation of groundwater and surface water quality conditions in the Santa Cruz AMA and to identify the interface of water quality concerns with water supplies. The impact of water quality on water resource management has become more important in recent years due to such factors as stringent water quality standards, conjunctive use of water supplies, groundwater management at remediation sites, and increasing levels of public concern.

The municipal, agricultural, and industrial sectors have distinctive demand patterns and water quality requirements. For example, state law prohibits direct use of treated effluent for potable use, but treated effluent can be used for turf irrigation, agricultural irrigation, cooling towers, and groundwater recharge. Water high in total dissolved solids (TDS) may be inappropriate for agricultural irrigation but may be used for some industrial applications. Water high in nitrate could be suitable for agriculture, but does not meet potable standards. During the third management period, the Department will evaluate matching water quality characteristics with appropriate end uses while ensuring compliance with applicable laws and rules for each end use.

7.5.2 Renewable Water Supplies

Other than effluent, surface water flow is a source of renewable water in the Santa Cruz AMA. The quality of surface water and effluent supplies is discussed in this section.

7.5.2.1 Surface Water

Surface water quality in the Santa Cruz AMA is generally good. Surface water sources available for use in the Santa Cruz AMA include Patagonia and Peña Blanca lakes, intermittent and ephemeral flow in the microbasin and northernmost reaches of the Santa Cruz River and Nogales Wash, and the effluent-dominated reach of the Santa Cruz River. Water quality in Patagonia Lake is generally good. There have been some instances of mercury present in some fish in Peña Blanca lake, but this metal has not been detected in the water to date. The surface water in Nogales Wash is considered poor quality due mostly to sewer lines leaking in both Nogales, Sonora and Nogales, Arizona. The effluent dominated reach of the Santa Cruz River has a water quality that meets treated effluent water quality standards.

7.5.2.2 Effluent

Effluent is defined by A.R.S. § 45-101(4) as “water that has been collected in a sanitary sewer for subsequent treatment in a facility that is regulated pursuant to A.R.S. §§ 49-361 and 49-362. Such water remains effluent until it acquires the characteristics of groundwater or surface water.” Sanitary sewers are

comprised of any pipe or other enclosed conduit that carries any waterborne human wastes from residential, commercial, and industrial facilities. A.R.S. § 45-101(8).

Effluent treated at the Nogales International Wastewater Treatment Plant (NIWWTP) in Rio Rico treats municipal wastewater from both Mexico and Arizona and is a significant source of renewable water supply in the Santa Cruz AMA. Although not suitable for human consumption without advanced treatment, effluent is suitable for turf irrigation, agricultural irrigation, sand and gravel washing, and several other industrial applications. Wastewater reuse rules are developed by ADEQ and establish parameters for wastewater reuse options.

Effluent from the NIWWTP is discharged into the Santa Cruz River stream channel. The area from the plant downstream to Chavez Siding Road has a perennial flow and is considered to be the effluent dominated reach of the Santa Cruz River. Wastewater discharges require a NPDES permit to ensure that water quality parameters are being met.

7.5.3 Groundwater Supplies

Groundwater is one of the most important sources of water in Arizona. Most of the groundwater supplies in the Santa Cruz AMA are of acceptable quality for most uses. However, some aquifers have been degraded as a result of contamination.

The introduction of contaminants into aquifer systems degrades groundwater quality and threatens public health and the environment. Contaminants can migrate into areas of potable groundwater supplies due to groundwater pumping or regional groundwater flow patterns. Many areas of the Santa Cruz AMA are projected to remain dependent on groundwater pumping, thereby potentially causing migration of contaminants. The Department's role in managing potential contaminant migration is through involvement in site-specific and non-site specific water quality management.

Groundwater that has been degraded has limited beneficial uses due to chemical, biological, or radiological contamination and may have high treatment and delivery costs associated with its use. Despite these limitations, the Department considers poor quality groundwater to be a valuable resource for future water management and encourages appropriate uses of this water supply. Matching the highest beneficial use with poor quality groundwater is an important aspect of water management. Frequently, poor quality groundwater is remediated and reinjected into the aquifer because it is not economically feasible to convey the treated water to a location for a higher beneficial use.

Recognizing that there may be impacts resulting from surface water recharge, the EPA requires states to develop a rule for groundwater under the influence of surface water. ADEQ has adopted a rule (A.A.C. R18-11-405) which stipulates that groundwater under the direct influence of surface water requires more extensive treatment than groundwater.

7.5.4 Groundwater Constituents and Their Impacts on Water Quality Management

The management of water resources requires an understanding of how water quality impacts aquifer conditions and potential uses. Drinking water quality regulations are developed to ensure that the intended use will not have harmful impacts on human health. The Department and ADEQ evaluate water quality based on ADEQ's numeric and narrative AWQSS as well as EPA's primary and secondary MCLs, commonly expressed as mg/l or µg/l. Appendix 7A provides a more detailed list of primary MCLs for selected Volatile Organic Compounds (VOCs), pesticides, inorganic metals, radiochemicals regulated under the Arizona Drinking Water Rules, and other selected contaminants. Appendix 7A also includes a brief description of the potential human health effects and sources of these contaminants in drinking water.

Appendix 7B lists the secondary MCLs for selected contaminants. Secondary MCLs are non-enforceable aesthetic standards.

The following sections briefly describe the impact of selected constituents on groundwater management and public health. ADEQ's Arizona Water Quality Assessment was used as a reference for descriptions of the limitations on uses, present and planned remedial activities, and potential uses of poor quality groundwater for each constituent. The Department's own databases were used to describe water quality in the Santa Cruz AMA.

7.5.4.1 Nitrate

Nitrates are salts formed from nitrogen compounds and are one of the most common groundwater contaminants detected in Arizona. Low nitrate concentrations in groundwater may originate from natural sources such as organic acids. Elevated nitrate levels are generally attributed to industrial sources, wastewater treatment plants, septic tanks and leach fields, or agricultural fertilizers.

Water containing high levels of nitrate-nitrogen cannot be delivered as a drinking water supply unless it is equal to or reduced below the MCL of 10 mg/l. Adults can tolerate high levels of nitrate-nitrogen, although water containing more than several hundred mg/l can cause gastrointestinal irritation. Water that contains nitrate in concentrations in excess of the MCL can be harmful to infants. Nitrate may also be harmful to livestock at levels exceeding several thousand mg/l.

Nitrate stimulates plant growth and is typically regarded as a desirable constituent under most agricultural and turf-related watering uses. For this reason, effluent is often sought as a source of irrigation water. Nitrogen fertilizer application rates may be reduced or eliminated if irrigation water contains elevated nitrate levels.

Nitrate concentrations above the MCL of 10 mg/l have been detected in Nogales Wash at the international border.

7.5.4.2 Sulfate

Sulfate can occur as a natural inorganic constituent of groundwater which originates from the natural dissolution of minerals in aquifers. Elevated concentrations can result from the leaching of industrial wastes and agricultural fertilizers. High sulfate concentrations are often found in aquifers underlying current or historic agricultural lands, mining areas, and areas of natural mineralization.

The EPA has not established a primary MCL for sulfate. The EPA is scheduled to complete studies of the human and health effects of sulfate and to decide whether to establish a drinking water MCL in August, 2002. The secondary MCL for sulfate is 250 mg/l.

Elevated sulfate concentrations in drinking water supplies can cause problems due to taste and laxative effects and can lead to scale formation in evaporative cooling systems. The diverse nature of industrial water quality requirements create specific needs for different industries. Some industries require very low sulfate levels while others can use water with elevated sulfate levels. High sulfate concentrations in groundwater do not commonly limit agricultural water use.

Sulfate levels above the secondary MCL are prevalent along the Nogales Wash and the Santa Cruz River downstream of the NIWWTP.

7.5.4.3 Total Dissolved Solids

TDS content is a measure of the dissolved minerals present in water and is a general indication of inorganic water quality. Components of TDS include inorganic compounds such as calcium, magnesium, sodium, potassium, sulfate, bicarbonate, chloride, and silica. In most areas, the primary components of TDS are derived naturally as groundwater dissolves minerals present in aquifers. TDS concentrations can also be elevated by agriculture, industry, and wastewater treatment facility discharges.

The EPA has established a secondary MCL of 500 mg/l for TDS. High TDS concentrations, which result in scaling and mineral accumulation, can have an adverse economic impact on water distribution systems and household plumbing and appliances. Though no permanent harmful effects have been observed from drinking high TDS water, some people may find the taste of this water to be less desirable than lower TDS water.

The concentration of TDS that limits water use varies widely among industries. High TDS water is a primary concern of a few industries (such as the semiconductor industry) that require water so pure they must treat almost any source water to obtain the necessary quality. Other industries, such as sand and gravel operations, can use water with very high TDS concentrations. The application of water containing high concentrations of TDS on turf-related facilities can impact turf quality and clog irrigation sprinkler heads if proper management techniques are not followed.

Water within the Santa Cruz AMA exhibits TDS concentrations at or below 500 mg/l. The highest concentrations are along the Nogales Wash and the Santa Cruz River downstream of the NIWWTP.

7.5.4.4 Metals

The EPA has designated 13 priority pollutant metals and has established primary MCLs for 10 of the metals that occur in drinking water: antimony, arsenic, barium, beryllium, cadmium, chromium, mercury, nickel, selenium, and thallium. The primary MCL for nickel has recently been remanded for further review by the EPA. The EPA promulgated primary MCL goals and National Primary Drinking Water Rules for lead and copper in June of 1991. High concentrations of metals in groundwater are typically associated with industrial wastes. Some metals occur naturally in groundwater, depending on the geology of the aquifer and the geochemical equilibrium between aquifer materials and groundwater.

The health effects associated with exposure to metals vary depending on the constituent and concentrations. Some metals such as selenium and chromium are known to be essential for human nutrition and are beneficial in certain concentrations. Others, such as lead, have no known beneficial effects on human or animal development and are harmful in high concentrations. Limitations on industrial and agricultural use of water with high concentrations of metals vary considerably depending on the contaminant present and the associated use.

Problems with metals are uncommon in the Santa Cruz AMA.

7.5.4.5 Volatile Organic Compounds

VOCs, such as trichloroethylene (TCE) and tetrachloroethylene (PCE), are chemicals that evaporate easily but do not readily dissolve in water. Other VOCs include acetone; vinyl chloride; 1,2-dichloroethane; benzene; 1,1-dichloroethylene; 1,1-dichloroethane; chloroform; toluene; and methylene chloride. VOCs are present in or are used for the manufacturing of, many substances including degreasers, solvents, plastics, paint, varnish, finish removers, detergent, medicine, and gasoline. When found in groundwater, VOCs are usually associated with industrial areas, landfills, and other sites used for the improper disposal of chemicals.

Health effects associated with VOCs in drinking water are complex and vary with the types of compounds and concentrations present. Some VOCs, such as TCE, are suspected human carcinogens while others have been associated with damage to internal organs. Drinking water supplies which exceed primary MCLs for VOCs must be treated prior to use.

The use of water containing VOCs for industrial and agricultural applications must be examined on an individual basis. Treatment processes for the removal of VOCs must be adequate to meet the intended use of the remediated water. Air quality regulations also need to be considered prior to the use of water contaminated with VOCs.

VOCs exceeding the MCLs are found at the RCRA site near the United Musical Instruments Plant (UMI) in Nogales and at several isolated locations along the Nogales Wash.

7.5.4.6 Petroleum Hydrocarbons

This class of contaminants includes non-halogenated hydrocarbons such as benzene, toluene, ethyl benzene, and xylenes, which are ingredients of gasoline and other fuels. Leaking underground fuel storage tanks and distribution systems are a common source of groundwater contamination by petroleum hydrocarbons. According to ADEQ, there are over 5,700 reported leaking UST systems in Arizona. Many of these leaking USTs have been investigated and remediated.

Leaking UST facilities have been identified in the Santa Cruz AMA. Some of these sites have affected water supplies but at levels at or below MCLs. The probable source of contamination at most of these locations is leaking tanks associated with gasoline stations, commercial, and industrial sites. The sites identified have varying degrees of groundwater contamination and are in various stages of remediation.

7.5.4.7 Pesticides

Pesticides are synthetic and natural organic chemicals which are used as insecticides, rodenticides, and herbicides. Pesticides may be detected in groundwater underlying areas irrigated for agriculture and turf grass.

The health effects of pesticide exposure in water are varied and complex, depending on both the pesticide's inert and active ingredients and reaction with substances contained in the water. Drinking water supplies can be affected by pesticide contamination. The presence of pesticides can restrict some industrial and agricultural water uses such as animal-based industries and vegetable production because elevated concentrations of pesticides may bioaccumulate (accumulate in living tissue) as they are passed through the food chain.

There are no known sites of pesticide concentrations in the Santa Cruz AMA.

7.5.4.8 Fluoride

Fluorides are compounds found in rocks and soil and some industrial waste products. Fluorides are used primarily in manufacturing and as a drinking water additive for the prevention of tooth decay. Fluoride occurs naturally in groundwater; however, the acceptability of water containing fluoride for domestic or municipal use depends on the concentration level.

Concentrations of fluoride in excess of the MCL have not been found in the Santa Cruz AMA. However, fluoride has been detected at concentrations below the MCL along the Nogales Wash.

7.5.4.9 Radiochemicals

Radioactive elements such as uranium, radon, and radium occur naturally in soil and water at locations throughout Arizona. The federally proposed primary MCL for radon is 300 picocuries per liter, but radon in groundwater is not regulated at this time. The EPA is currently collecting data on radon occurrences and conducting a health effects study prior to promulgating a radon standard for drinking water. Inhalation of radon may be harmful when it is released to the air from a contaminated water source. The primary concern of using radon-contaminated water is to ensure that the release of emissions are below air quality standards when processes such as cooling towers, construction aggregate washing, and sprinkler irrigation are used.

In the Santa Cruz AMA, naturally occurring contaminants such as radon affect groundwater in some areas which are generally located near hardrock formations.

7.5.5 Specific Contamination Areas

This section contains a description of the specific groundwater contamination areas which have been identified in the Santa Cruz AMA. Unless otherwise indicated, each of these sites are listed on the WQARF Priority List or the NPL. A summary of individual remedial sites in the Santa Cruz AMA are provided below. The status of each remedial site was obtained from the WQARF Quarterly Report submitted to the state Joint Legislative Budget Committee by the ADEQ for the period of July 1, 1997 through March 31, 1998.

- **Nogales United Musical Instruments Plant RCRA Site.** Located in northwest Nogales, this site exhibits groundwater contamination from TCE and dichloroethylene (1,1-DCE). Concentrations of 0.2-400 ug/l of TCE and 0.2-2500 ug/l of 1,1 DCE are present. This project is currently remediating the contaminated water utilizing aeration towers. The treated water is subsequently transported to a holding pond and the treated water is used to irrigate the Palo Duro golf course in Nogales.
- **Nogales Wash WQARF Site.** The Nogales Wash site encompasses the entire length of the wash from the international border to the confluence with the Santa Cruz River. Varying levels of contaminants have been detected in wells sampled along the wash. However, the extent of the various contaminations are not yet fully defined. This WQARF site includes one of the aquifers that serves as a source of water for several providers in the Santa Cruz AMA.

7.6 THIRD MANAGEMENT PLAN PROGRAM SUMMARY

Most groundwater supplies in the Santa Cruz AMA are of acceptable quality for most uses. However, human activity and natural processes have resulted in the degradation of groundwater quality in a few areas to the extent that it is unusable for many purposes. The extent and type of contamination varies by location and land use activities. In general, contaminated groundwater in the Santa Cruz AMA is caused by human activity. Concentrations of wells withdrawing water can influence the migration of poor quality water. While the UMI site is currently undergoing remediation, remedial investigations are still underway at the Nogales Wash site.

As WQARF activities progress, addressing water management issues such as available supply and reuse options will become essential to ensure a long-term water supply of adequate quality. The ability to recognize specific groundwater management requirements for contaminated and degraded aquifer conditions will also become increasingly important as the demand for water increases.

During the first and second management periods, ADEQ emphasized pump and treat remedies to cleanup poor quality groundwater. Success was limited, however, due to lengthy periods of litigation which have seriously restricted actual cleanup activities. With the advent of the WQARF reform package of 1997, a new approach emphasizing incentives to cleanup and flexibility in the selection of remedies was developed to improve the likelihood that sites will actually be remediated.

The 1997 WQARF reform legislation creates an incentive for the use of groundwater withdrawn in accordance with approved remedial action projects pursuant to Title 49, Arizona Revised Statutes, or CERCLA. It provides that such groundwater must be accounted for consistent with accounting procedures used for surface water and that the use of certain volumes of such groundwater is consistent with achievement of the management goals of the AMA until the year 2025. During the third management period, the Department will amend its AWS Rules to conform to these provisions. Additionally, permanent rules regarding general well spacing and impact will be promulgated by the Department during the third management period. The Department also intends to integrate water quality concerns more fully into its underground water storage programs.

During the third management period, the Department intends to enact and implement the provisions outlined in this chapter. This commitment will encompass the new provisions and activities summarized below:

- An on-going groundwater quality assessment in cooperation with ADEQ will assist with the evaluation of existing rules and provisions and provide better data to the public.
- Integration of groundwater quality management into recharge planning and permitting, and development of incentives to use remediated groundwater where appropriate.
- Formal permit coordination with ADEQ on both Title 45 and Title 49 permits. Basin-wide or non-site specific tracking and coordination of all permits will provide both agencies with a more complete picture of contaminant distribution, groundwater withdrawals, and releases to groundwater and surface water.
- Evaluation of the need for additional incentives to withdraw and remediate groundwater in an effort to match quality with beneficial use. This evaluation will include groundwater that may be contaminated with hazardous, non-hazardous, and naturally occurring substances. Incentives may involve amendments to Title 45, Arizona Revised Statutes, Department rules and policies, or a modification of the management plans.
- The Department and ADEQ will develop and enter into Memorandums of Understanding, as necessary, to establish, among other things, the division of responsibilities for the implementation of the reformed WQARF Program, development of common scopes of work for WQARF sites and other groundwater contamination sites, and database development and exchange.

The Department's Water Quality Section, which was established with funding provided by the 1997 WQARF reform legislation, will allow the Department to strengthen its commitment to work closely with ADEQ to resolve groundwater quantity and quality issues throughout Arizona.

Other remedial activities and management action plans such as those associated with Superfund sites will continue to include the Department's direct involvement. This will ensure that remedial activities meet the Department's water management objectives and are consistent with the AMA's goals.

7.7 FUTURE DIRECTIONS

The Department's long-range plans for groundwater quality management will focus on two areas: (1) evaluation of groundwater quality issues on a site and non-site specific level to understand the impact of broader groundwater quality issues on water resource management and (2) preservation of AMA management goals and interests while implementing incentives to use remediated groundwater.

7.7.1 Non-Site Specific Groundwater Quality Management

Non-site specific groundwater quality management refers to groundwater quality management activities which may occur in general areas located outside of an identified WQARF or CERCLA boundary. To address and mitigate dispersed contamination over large areas, a broader management strategy is needed. Areas which may need more intensive management can include those where public or private supply well have been or may be affected by contamination. For instance, areas that are in the vicinity of major population centers or agricultural areas can be affected by contaminants, especially if large volumes of water are withdrawn from wells, creating cones of depression.

The concept of groundwater quality management on a non-site specific scale will be developed to enhance water management activities in critical areas. The identification of source groundwater quality and the development of area-specific plans to match water quality with the intended use will become an important aspect in the third management period. The Department intends to study the development of area-specific plans that could employ a combination of strategies to evaluate and mitigate the effects of contamination in critical areas. These plans should be developed in coordination with ADEQ and with affected stakeholders. Any contaminant management on a non-site specific scale will be voluntary and will not affect rights to water, well ownership, delivery responsibilities, or existing permits.

7.7.2 Preservation of AMA Management Goals

The WQARF reform package of 1997 was designed to encourage the remediation of groundwater that has limited or no use due to contamination. Pump and treat groundwater remediation activities are anticipated to increase substantially during the third management period as a result of the remediated groundwater use incentives provided in the WQARF reform package. As a result, previously unavailable sources of groundwater from contaminated areas may be put to beneficial use.

Remediated groundwater withdrawals associated with WQARF, CERCLA, Department of Defense, RCRA, and voluntary site cleanups are expected to increase. Estimates of annual remediated groundwater withdrawals, provided by ADEQ and its contractors for existing remedial sites within the Santa Cruz AMA may be in the range of 3,000 acre-feet annually. This estimate is approximate and is subject to change based on future remedial activities. Additionally, the Nogales Wash site in the AMA is not represented in this estimate due to a lack of information. This estimate may be conservative because remedial activities are in different stages of development and additional sites may be identified in the future.

In the third management period, the Department will monitor water levels and effects on local water providers at remedial project sites in areas of intensive pumping. While the Department supports the remediation of contaminated groundwater, it also seeks to preserve the management goals of the Santa Cruz AMA. Water quality management is a lengthy process which is expected to continue far beyond the scope of the third management period. Continued remedial activities over the long-term will likely result in considerable volumes of groundwater being pumped, treated, and subsequently used.

The net effect of continued remediated groundwater withdrawals could result in an increase in the overall volume of groundwater used within the Santa Cruz AMA. Proper water quantity and water quality management will be required to ensure that groundwater use created as a result of remedial projects does

not impact the goals of the Santa Cruz AMA. Remediated groundwater is not a renewable water supply and therefore must be managed as a diminishing resource. Consequently, the Department will seek to preserve the intent of the Code and the AMA management goals while cooperating with EPA, ADEQ, and other agencies to promote groundwater quality management.

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
SANTA CRUZ ACTIVE MANAGEMENT AREA
(Source: ADEQ Drinking Water Rules, April 28, 1995)

Contaminant	Primary MCL (mg/l) ¹	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Inorganics			
Antimony	0.006	Cancer	Fire retardants, ceramics, electronics, fireworks, solder
Arsenic	0.05	Skin, nervous system toxicity	Natural deposits; smelters, glass, electronics waste
Asbestos	7.0 MFL ²	Cancer	Natural deposits, asbestos cement in water systems
Barium	2.0	Circulatory system effects	Natural deposits, pigments, epoxy sealants, spent coal
Beryllium	0.004	Bone, lung damage	Electrical, aerospace, defense industries
Cadmium	0.005	Kidney effects	Galvanized pipe corrosion; natural deposits, batteries, paints
Chromium (total)	0.1	Liver, kidney, circulatory disorders	Natural deposits; mining, electroplating, pigments
Cyanide (as free cyanide)	0.2	Thyroid, nervous system damage	Electroplating, steel, plastics, mining, fertilizer
Fluoride ³	4.0	Skeletal and dental fluorosis	Natural deposits; fertilizer, aluminum industries
Mercury	0.002	Kidney, nervous system disorders	Crop runoff; natural deposits; batteries, electrical switches
Nickel	Remanded	Gastrointestinal distress, skin irritation, respiratory congestion	Food, water, and metal alloys
Nitrate (as N)	10.0	Methemoglobinemia	Animal waste, fertilizer, sewage, natural deposits, septic tanks
Nitrite (as N)	1.0	Methemoglobinemia	Same as nitrate; rapidly converted to nitrate
Total nitrate/nitrite	10.0	Same as nitrate	Same as nitrate
Selenium	0.05	Liver Damage	Natural deposits; mining, smelting, coal/oil combustion
Thallium	0.002	Kidney, liver, brain, intestinal	Electronics, drugs, alloys, glass

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SANTA CRUZ ACTIVE MANAGEMENT AREA
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Contaminant	Primary MCL (mg/l) ¹	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Volatile Organic Chemicals			
Benzene	0.005	Cancer	Some foods; gas, drugs, paint, pesticides, plastic industries
Carbon tetrachloride	0.005	Cancer	Solvents and degradation by-products
ortho-Dichlorobenzene	0.6	Liver, kidney, blood cell damage	Paints, dyes, engine cleaning compounds, chemical wastes
para-Dichlorobenzene	0.075	Cancer	Room and water deodorants, and mothballs
1,2-Dichloroethane	0.005	Cancer	Leaded gasoline, fumigants, paints
1,1-Dichloroethylene	0.007	Cancer	Plastics, dyes, perfumes, paints
cis-1,2-Dichloroethylene	0.07	Liver, kidney, nervous, circulatory	Waste industrial extraction solvents
trans-1,2-Dichloroethylene	0.1	Liver, kidney, nervous, circulatory	Waste industrial extraction solvents
Dichloromethane	0.005	Cancer	Paint stripper, metal degreaser, propellant, extraction
1,2-Dichloropropane	0.005	Liver, kidney effects; cancer	Soil fumigant; waste industrial solvents
Ethylbenzene	0.7	Liver, kidney, nervous system	Gasoline; insecticides; chemical manufacturing wastes
Monochlorobenzene	0.1	Nervous system and liver effects	Waste solvent from metal degreasing process
Styrene	0.1	Liver, nervous system damage	Plastics, rubber, resin, drug industries; landfill leachate
Tetrachloroethylene	0.005	Cancer	Improper disposal of dry cleaning and other solvents
Toluene	1.0	Liver, kidney, nervous, circulatory	Manufacturing and solvent operations, gasoline additive
1,2,4-Trichlorobenzene	0.07	Liver, kidney damage	Herbicide production, dye carrier
1,1,1-Trichloroethane	0.2	Liver, nervous system effects	Adhesives, aerosols, textiles, paints, inks, metal degreasers
1,1,2-Trichloroethane	0.005	Kidney, liver, nervous system	Solvent in rubber, other organic products; chemical production wastes
Trichloroethylene	0.005	Cancer	Textiles, adhesives, and metal degreasers

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
SANTA CRUZ ACTIVE MANAGEMENT AREA
(Source: ADEQ Drinking Water Rules, April 28, 1995)

Contaminant	Primary MCL (mg/l) ¹	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Vinyl chloride	0.002	Cancer	May leach from PVC pipe; formed by solvent breakdown
Xylenes (total)	10.0	Liver, kidney, nervous system	By-product of gasoline refining; paints, inks, detergents
Synthetic Organic Chemicals			
Alachlor	0.002	Cancer	Runoff from herbicides applied to crops
Atrazine	0.003	Mammary gland tumors	Runoff from herbicides used on crops and non-cropland
Benzo(a)pyrene	0.0002	Cancer	Fossil fuels, burning organic matter, coal tar coatings, volcanics
Carbofuran	0.04	Nervous, reproductive system effects	Soil fumigant; some area restrictions apply
Chlordane	0.002	Cancer	Leaching from soil treatment for termites
2,4-D	0.07	Liver and kidney damage	Runoff from herbicides applied to crops, rangelands, and lawns
Dalapon	0.2	Liver and kidney effects	Herbicide on orchards, crops, lawns, road/railways
Dibromochloropropane	0.0002	Cancer	soil fumigant
Di(2-ethylhexyl)adipate	0.4	Decreased body weight	Synthetic rubber, food packaging, cosmetics
Di(2-ethylhexyl)phthalate	0.006	Cancer	PVC and other plastics
Dinoseb	0.007	Thyroid, reproductive organ damage	Runoff of herbicide from crop and non-crop applications
Diquat	0.02	Liver, kidney, eye effects	Runoff of herbicide on land and aquatic weeds
Endothall	0.1	Liver, kidney, gastrointestinal	Herbicide on crops, land/aquatic weeds; rapidly degraded
Endrin	0.002	Liver, kidney, heart damage	Pesticide on insects, rodents, birds; restricted since 1980
Ethylene dibromide	0.00005	Cancer	Leaded gasoline additives; leaching of soil fumigant
Glyphosate	0.7	Liver, kidney damage	Herbicide on grasses, weeds, brush
Heptachlor	0.0004	Cancer	Leaching of insecticide for termites and very few crops
Heptachlor epoxide	0.0002	Cancer	Biodegradation of heptachlor

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
SANTA CRUZ ACTIVE MANAGEMENT AREA
(Source: ADEQ Drinking Water Rules, April 28, 1995)

Contaminant	Primary MCL (mg/l) ¹	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Hexachlorobenzene	0.001	Cancer	Pesticide production waste by-product
Hexachlorocyclopentadiene	0.05	Kidney, stomach damage	Pesticide production intermediate
Lindane	0.0002	Liver, kidney, nervous, immune circulatory	Insecticide on cattle, lumber, gardens; restricted in 1983
Methoxychlor	0.04	Growth, liver, kidney, nerve effects	Insecticide for fruits, vegetables, alfalfa, livestock, pets
Oxamyl (Vydate)	0.2	Kidney damage	Insecticide on apples, potatoes, tomatoes
Pentachlorophenol	0.001	Cancer, liver and kidney effects	Wood preservatives, herbicide, cooling tower wastes
Picloram	0.5	Kidney, liver damage	Herbicide on grass sod, some crops, aquatic algae
Polychlorinated biphenyls	0.0005	Cancer	Coolant oils from electrical transformers; plasticizers
Simazine	0.004	Cancer	Herbicide on grass sod, some crops, aquatic algae
2,3,7,8-TCDD (Dioxin)	3 x 10 ⁻⁸	Cancer	Chemical production by-product; impurity in herbicides
Toxaphene	0.003	Cancer	Insecticide on cattle, cotton, soybeans; canceled in 1982
2,4,5-TP (Silvex)	0.05	Liver and kidney damage	Herbicide on crops, rights-of-way, golf courses; canceled in 1983
Radionuclides			
Combined Radium-226 and Radium-228	5 pCi/l ⁴	Bone Cancer	Natural deposits
Gross Alpha ⁵	15 pCi/l	Cancer	Decay or radionuclides in natural deposits
Gross beta	4 mrem/yr ⁶	Cancer	Decay of radionuclides in natural and man-made deposits
Radon-222 (Proposed)	300 pCi/l	Cancer	Natural sources
Uranium (Proposed)	20 µg/l ⁷	Cancer	Natural sources
Microbiology			
Giardia lamblia	TT ⁸	Gastroenteric disease	Human and animal fecal waste
Legionella	TT	Legionnaire's disease	Indigenous to natural waters; can grow in water heating systems

APPENDIX 7A
DRINKING WATER STANDARDS AND HEALTH EFFECTS
SANTA CRUZ ACTIVE MANAGEMENT AREA
(Source: ADEQ Drinking Water Rules, April 28, 1995)

Contaminant	Primary MCL (mg/l)¹	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Standard Plate Count	TT	Indicates water quality, effectiveness of treatment	
Total Coliform	⁹	Indicates gastroenteric pathogens	Human and animal fecal waste
Turbidity	⁹	Interferes with disinfection, filtration	Soil runoff
Viruses	TT	Gastroenteric disease	Human and animal fecal waste
Total Trihalomethanes	0.1	Cancer	Drinking water chlorination by-products

¹ mg/l = milligrams per liter (all MCLs are in mg/l unless otherwise indicated)

² "MFL" means million fibers per liter greater than 10 microns

³ The MCL for fluoride applies to community water systems only

⁴ pCi/l = picocuries per liter (30pCi/l is equivalent to 20 µg/l)

⁵ Gross particle activity, including Radium-226 but excluding Radon and Uranium

⁶ mrem/yr = millirem per year, see ADEQ, Drinking Water Rules source (1) for more information

⁷ µg/l = micrograms per liter

⁸ Treatment Technology (refer to source (1) for more information)

⁹ Refer to source (1) for more information

Sources:

1. Arizona Department of Environmental Quality, Arizona Drinking Water Rules, April 28, 1995
2. United States Environmental Protection Agency, Office of Water 4304, EPA 822-B-96-002, October 1996
3. United States Environmental Protection Agency, National Primary Drinking Water Regulations, Appendix A: National Primary Drinking Water Standards (Modified 1/14/98)

APPENDIX 7B
SECONDARY DRINKING WATER STANDARDS¹
SANTA CRUZ ACTIVE MANAGEMENT AREA

Constituents	SMCLs (mg/l)²
Aluminum	0.05 to 0.2
Chloride	250
Color	15 color units
Copper	1.0
Corrosivity	non-corrosive
Fluoride	2.0
Foaming agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 threshold odor numbers
pH	6.5 - 8.5
Silver	0.1
Sulfate	250
Total dissolved solids	500
Zinc	5

¹ Secondary Drinking Water Standards are unenforceable federal guidelines regarding taste, odor, color and certain other non-aesthetic effects of drinking water. States may adopt their own enforceable regulations governing these concerns.

² Secondary Maximum Contaminant Levels (SMCLs) units are in milligrams per liter (mg/l) unless otherwise indicated.

Source:

United States Environmental Protection Agency, Office of Water 4304, EPA 822-B-96-002, October 1996.

APPENDIX 7C
POSSIBLE WATER QUALITY REMEDIES
SANTA CRUZ ACTIVE MANAGEMENT AREA

The bullets below describe various remedies that are available to address sites of contaminated groundwater.

- **Plume Remediation**

Plume remediation or aquifer restoration means achieving appropriate water quality standards for groundwater throughout the affected area. Source control and monitoring will likely be essential elements of this strategy. This remedy may be more effective for smaller plumes which can be remedied within reasonable time frames.

- **Physical Containment**

Physical containment refers to an approach that contains contaminants within defined boundaries. This strategy could consist of plume control and coordination of groundwater pumpage and recharge to ensure that contamination is confined within a defined area. Source control and monitoring are also likely elements of this strategy. Physical containment may be appropriate in cases where potable water supplies are threatened by contaminant migration and where containment is technically feasible, but it may require extensive groundwater management to implement.

- **Controlled Migration**

This strategy aims to control but not necessarily contain contaminant migration. Source control and monitoring are likely elements of this strategy. Control of contaminants can include control and/or coordination of pumpage that affects contaminant migration and any other measures taken to control contaminant migration. Controlled migration may be appropriate for larger plumes which cannot be practically remedied or contained.

- **Source Control**

Source control is a reduction of continuing contaminant sources such as soil contamination or areas of high concentrations of VOCs or other contaminants. Dense non-aqueous phase liquids (DNAPLs), which are contaminants (such as VOCs) of such high concentrations that they are not dissolved in groundwater but exist as free phase liquids, are an example of contaminant sources. Source control is a remedial action that often results in the highest volume of contaminants removed per unit cost.

This strategy employs controlling the pollutant at the source to ensure that aquifer contamination does not migrate due to uncontrolled contaminant releases. Monitoring is a likely component of this strategy. Source control can include, but is not limited to, the remediation of sorbed or free phase contaminants, pumpage of groundwater to contain or control significant sources of contaminants, and the removal of contributing contaminant sources.

- **Monitoring**

Monitoring water quality conditions, instead of implementing actual cleanup activities, can be a remedy applied to sites with low risk to human health or the environment. Monitoring sites is also an important part of many remediation plans to assess the extent of contamination and the effectiveness of remedial activities. Computer groundwater models may be used to predict contaminant movement, to monitor well locations, and to develop contingency plans for more aggressive remedies, if necessary.

APPENDIX 7C (continued)
POSSIBLE WATER QUALITY REMEDIES
SANTA CRUZ ACTIVE MANAGEMENT AREA

- **No Action**

This alternative consists of taking no action at a site. The site is not monitored nor are any remedial actions performed. This strategy is normally included as a baseline condition for comparison purposes in a remedial investigation feasibility study, but may be a viable alternative in limited cases. Generally, this alternative would only be chosen for sites that are geographically isolated from populated areas, do not pose a significant threat to drinking water supplies, or would be used for comparative purposes to other sites.